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Socio-Economic Analysis of the Operational Impacts of Shiroro Hydropower Generation in the Lowland Areas of Middle River Niger

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Abstract
This study focused on the socio-economic analysis of the operational impacts of Shiroro hydroelectric power generation dam in the lowland areas of middle river Niger in Nigeria. The paper observed that more than thirty years since the conception and impoundment of water at Kanji over river Niger a number of action or inaction capable of altering the socio-economic profile of the riparian communities around the lowland areas of middle river Niger in Nigeria have taken place. The study therefore designed and administered a close-ended pre-coded instrument to conduct a survey of the dam affected communities located in the study area. The data harvested were analyzed using the Principal Component Analysis (PCA). The result obtained shows that the economic engagements of the riparian communities have been distorted. This is noticeable especially on both fish biodiversity and ecosystem with a resultant loss of fish-species. There is a dismal fall in productivity of small holder farmers and fishermen occasioned by avoidable flooding. In the same vein Strategic social and economic infrastructure have deteriorated and thus slowed down the socio and economic development in the area. In this connection a number of policy measures to mitigate the negative effect of hydropower production were suggested.
Key words: Dams, Hydropower, Socio-Economic, Impact and, Mitigation

JEL Classification: C81, C82, C93, Q5

I. Introduction

Nigeria has over forty years history of hydro-electric power development in Africa South of Sahara (ASS) starting with the Kainji Dam on the lower part of River Niger. The primary purpose of these dams (Jebba, Kainji on River Niger and Shiroro on River Kaduna) was to serve as engine of growth and development. This role has been performed creditably well by supplying not only Nigeria but also those neighbouring countries for which River Niger is a common wealth,

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with the needed energy to power the growing economy. Either by design or by the geographical configuration the three dams are located in the Niger State of Nigeria.

The construction of dams in the country is given so much of structural or engineering consideration with inadequate post deployment environmental impact assessment. Any water impoundment has the tendency to create both negative and positive effects on the environment, ranging from the resettlement problems to perennial flooding, destruction of flora, fauna, loss of farm lands and fish species, displacement from ancestral heritage and exposure to alien diseases.

No doubt the authority of the dams have been conducting environmental scanning, this has however been localized to the dam sites and engineering problem of the dam. There is scanty if any, study on the socio-economic analysis of large dams on the environment in Nigeria. This served as the motivation for this study apart from the imperative that an environmental scan which will encompass the upstream, and the downstream is long overdue for the following reasons: -

Firstly, the dam one of the largest man-made lakes in Nigeria and supposedly contributes substantial energy to the national grid, and in view of it size contribute more environmentally induced problems than other dams in the country. Secondly, the dam is designed to be multipurpose in use, and therefore available for other uses such as irrigation, recreation, research and development. Hence, a study of their impacts is desirable. Finally, the large communities of people within and around this man- made lake also suggest why such a study is desirable. This is the focus of this paper.

The rest of this study is organized into four sections: - section II is the review of existing evidence, while section III discussed the methodology. In section IV the paper discussed and analyzed the result of the survey. Section V of the paper presents the conclusions and recommendations.

Section II: Review of Existing Evidence

Large dams are known to have both negative and positive impacts on their immediate and adjoining environment and capable of altering the harmonious interrelationship between the environment and human activities. This is particularly so in most developing countries where safety nets are either ill provided or is entirely absent. The concept of living in harmony with nature dated back into antiquity. As a follow-up on this, in the 1960s to early 1970s, the concept of sustainable development came into limelight, with the view that any development that meets the needs of today, must not compromise the ability of the future generation to meet their own needs (WCED, 1987). The emphasis of sustainable development is on the interplay between 3 dimensions of sustainability namely: social, economy and the environment. Two schools of thought exist in this discussion, these are: the 'weak' and the 'strong' sustainability schools (Beckerman, 1995 and Niemeyer, 2003). The strong school of thought is the radical type which believes that pursuit of development must not lead to disastrous consequences on the environment, and that resources are better left unharnessed as such will deteriorate the environment. The 'weak' school on the other hand is premised on collaboration and on sensible compromise; with the effect that poverty eradication for

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example, cannot be realized without modification to the ecosystems. Therefore trade-off should be expected in resource development and deployment to a limit that permits coexistence between the social, economic and the environment without unwarranted damage to lives and properties.

It has been estimated that there are about 45,000 large dams in the world. Hydropower account for 16% of the world total energy production and 80% of Nigeria energy production, its inception in Nigeria dated to back to 1898. Criticism of the hydropower projects has increased since the 1190s, but the hydropower industry too has risen to these challenges, by taking various types of measures. The hydropower technology in itself does not impede the ability of future generations in meeting their needs. This explains why it is recommended by the Millennium Development Goals (MDGs) as a medium of eradicating poverty. Sustainable development and the way hydropower has sometimes been developed have not always been in harmony. The problem of hydropower development has recently been complicated with the climate change issues since 2000. Meanwhile, irrespective of the perspective it's viewed, HEP will have negative and positive consequences. Some of the expected consequences may include the provision of low operating and maintenance costs, possession of long life span (50-100 years), water storage and release flexibility, provision of reliable service and proven technology. It also instigates and fosters regional development, makes water available for other uses, provides highest energy efficiency rate (pay back ratio and conversion process), instigation of revenue generation for other water uses such as tourism, irrigated agriculture, leisure, sports, etc. It creates employment opportunities particularly during the construction phase, avoids fossils fuels use and cost, provides energy independence by exploiting natural resources, and optimizes power supply of other generating options (thermal and variable renewable). It also have positive social cost such as creating opportunities for capacity building by local/indigenous governments, companies and individuals, often provides flood protection, may enhance navigation conditions, often enhances recreational facilities, enhances accessibility of the territory and its resources (access roads, ramps and bridges), provides opportunities for construction and operation with high percentage of local manpower, may improve living conditions through sustained livelihoods (freshwater, food supply). The positive environmental implications may also include: production of no atmospheric pollutants and only very few Green House Gases (GHGs) emissions, enhances air quality, produces no waste, and avoids depleting non renewable fuel resources (coal, gas and oil). It can also create new freshwater ecosystem with increased productivity, enhances knowledge and improves management of valued species due to study results. Finally, it neither consumes nor pollutes the water it uses for electricity generation purposes.

On the other hand the negative implication can be seen in the following respects: high upfront investment, hydrology dependency, in some cases, the storage capacity of reservoir may decrease due to sedimentation, requires long term planning and requires long term agreement. Also, it often requires foreign contractors and funding and conflicting water users can occur. It social negative implications include: involvement in resettlement, local land use pattern may be modified, water borne diseases vector may need to be checked, requires management of competing water uses, may impact local people's livelihood. Furthermore, construction phase

can be followed by unemployment, disrupt local relationship with land and water. The negative environmental consequences may include: inundation of terrestrial habitats, modification of hydrological regimes, and modification of aquatic habitats. Others include the fact that water quality needs to be modified and managed, barriers for fish migration, fish entrainment, species activities and population can be altered and sediment composition and transport can be altered (IHA,2003).

The impacts of hydro-electric dams have been widely studied across the world. For example, in Costa Rica hydro power dams has led to transformation of free flowing rivers of Sarapiqui into altered system physically and biologically, it has devastated 10% of stream length in the watershed upstream, and 31 km of stream have been devastated, it has increased competition and conflicts over freshwater resources and it has also promoted river conservation. In the same vein, emissions of green house gases due to hydro electric dam construction have also been documented (Louis, *et. al.* 2003, Fearnside, 2004; Giles, 2006; Mickinen, and Khan, 2010)). Baskaya, *et al* (2007) has also documented the impacts of hydro dams on habitat deterioration in Turkey to include: impacts on birds, waste generation, illegal hunting, inadequate rehabilitation and restoration, etc. The impacts of hydropower dams on culture have been widely documented in different parts of Africa. For example, Inskeep (2000) documented the impact of Pikirayi dam on ancestral landscape and the concomitant psychological trauma resulting in mental health problem in Zambia. Kinahan (2000) in Angola has also studied the impacts of hydro dams on the Himba pastoralist and the over 4,000 year's archival history. Hassan, (2000) and Gamal (2000) both examined the impacts of Aswan high dam on Nubian monuments and cultural heritage in Egypt and Sudan. Brandt (2000) also reported a negative dam impact in 2 World Bank sponsored dams in Somalia and Ethiopia respectively. About 600 archeological sites were destroyed in Somalia; while several pre historic stones and pottery materials were recovered from dam sites in Ethiopia.

More importantly, studies in America confirmed that America has about 75,000 dams, which are already having various impacts, it its more pertinent to note that the age of dam building is over in America as many of the dam are now at least 3 decade old. Hence, such a scenario has made America a good study sites on the effects of dams as all the positive and negative impacts are now presently feasible (Graf, 1999).

The Shiroro dam has generated some heat in the last few decades, for example, it is the only large hydro electric power plant that gives light to Nigeria but remains in darkness, as the settlement named Shiroro is not yet connected to the national grid (NATIONS, 2000). In 2009 youths numbering hundreds disrupted operations in the dam (PUNCH, 2009). Also, Shiroro community has made several appeals to federal government on the need for improved living standards. All of these call for study of the impacts of this dam on the immediate people.

III. The Study Area

Shiroro dam is located on latitude 9o 58` 25`` North and Longitude 6o 50` 6`` East. It owned by Power Holding Company of Nigeria (PHCN), and situated 550 meters downstream of the confluence of Kaduna River with its tributary, the Dinya. It was officially commissioned by the

then Military Head of State, on 20th June, 1990; but technical commissioning actually started with Unit 411G4 being synchronized to the National Grid on October 3, 1989 and the commissioning of the last Unit 411G2 being completed on January 21, 1990 . It has a capacity of 600-MW.

The dam is of the rock-fill type and stands 115 meters high above the original riverbed elevation, across Shiroro Gorge for a crest length of 700 meters. The width of the dam at its toe is over 300 meters while its crest, which accommodates a service road, is 7.50 meters wide. The crest of the dam has a heavy reinforced concrete parapet wall, more than 5 meters high, which is also designed to protect the top of the dam from the waves that will build up in the lake, under wind pressure. The body of the dam has no central impervious core; the imperviousness of the structure is ensured by a continuous reinforced concrete slab, placed with a special technique on its upstream face. The reservoir covers a total surface area of 320 sq. kilometers with agrossstoragecapacityof7billioncu.Metres.

The station has a total installed capacity of 600 MW from 4 generating units rated at 150 MW each at a head of 97 meters. Each unit comprises a vertical Francis hydraulic turbine unit controlled by an electro hydraulic governor. The turbine drives a synchronous generator of salient pole construction having a net output of 150 MW. The generator is excited by a static self-excitation system. The speed of rotation for the unit is 150 r/min. These turbine generators are capable of independent operation. Power is generated at 16-kv voltage level. A generator-transformer steps up the voltage to 330-kv voltage level for connection to the national grid via the agency of a 330-kv switchyard.

Hydrological Analysis of Shiroro operational data from 1990 to 2007 showed a very high correlation between the energy produced and the inflows and the turbine discharge. However, when the correlation between the energy generated and inflows was examined, a fairly poor correlation was observed which was deemed to be an indication that the operation of the reservoir has not been consistent over the years suggesting that the water in the reservoir has been grossly underutilized

IV. Data, Model and Method of Analysis

The study is a part of the project on the "Operational Impact of Hydroelectric Power Dams in the lower valley of middle river Niger". The study designed a close-ended pre-coded instrument to conduct a survey of the dam affected communities located in the study area. Five thousand (5000) questionnaires were administered in the resettled and satellite villages in the riparian communities. These settlements include Gbajibo, Garafini, Shagunu and Kainji.

The method of Principal Component Analysis (PCA) was employed to extract the relevant information that appeared noisy. The Eigen value/Eigenvector and rotated matrix approach were used for the data analysis. To establish the nature of relationship among variable simple regression analysis was also used.

The method of PCA is one of the most valuable non-parametric tools for extracting relevant information from a data set that is considered complex to a lower dimension. The principal objective of PCA is to compute the most meaningful basis to re-express a noisy data set with the view to filter out the noise and reveal the hidden structure of the data, (Shlens, 2005). What the PCA does is to ask whether it is possible to have a new basis which is a linear combination of the original basis that best expresses the data set. The implicit assumption

underlining the PCA is Linearity. This assumption made it easy to restrict the set of potential basis and it formalizes the assumption of continuity in the data set. In this study we already assumed linearity by implicitly stating that the data set gives the opportunity to interpolate between individual data point. This has also enabled the study to use simple regression analysis to determine the extent of the relationship between the different classes of variables. This was complemented with other inferential statistics like the orthogonal variance; Eigen value.

Given this assumption the PCA can now be reduced to re-expressing the data as a linear combination of its basis vectors.

Let X = original data set with an m x n matrix where each column is a single sample of our data.

Let Y = Linear representation of the original data with an m x n matrix related by linear transformation P.

PX = Y - - - - - - - - -1

Let p_i = row of P x_i = column of X

y_i = column of Y Equation 1 above represents the change in basis and can be interpreted in many ways:

a). P = matrix that transforms X into Y

b). P = geometric rotation and stretch which again transforms X into P

c). the row P (p_i - - - -p_m) are set of the columns of X From these interpretations

We can write PX = $\begin{bmatrix} p1 \\ \cdot \\ \cdot \\ pn \end{bmatrix} [x1 \dots xn]$ Y = $\begin{bmatrix} p1x1 & \cdots & p1xn \\ \vdots & \ddots & \vdots \\ pmx1 & \cdots & pmxn \end{bmatrix}$

The form of each column of Y will be $y_i \equiv \begin{bmatrix} p1x1 \\ \cdot \\ pmx1 \end{bmatrix}$

Each components of y_i is a dot product of x_i with the corresponding row in P.

That is the j^{th} Coefficient of y_i is a projection into j^{th} row of P. This is the fact the very form of an equation where y_i is a projection on to the basis of $[p1. \ . \ . \ .pm]$ therefore the row of P are the new set of basis vectors for representing columns of X. By assuming linearity the row vector $[p1. \ . \ . \ .pm]$ becomes the principal components of X. The main problem is to determine the best way to express X and to determine a good choice of P. This can be done either through reduction of noise, rotation and redundancy. A common measure of noise is signal – to – noise ratio SNR. In this connection we considered first the primary attributes of the environment of the Dam in terms of socio-economic and cultural and demographic actors. The details of the primary attributes are presented in table 1 below. $_+$ Components(C) with loading > 0.70 are selected for explanation.

The 37 socio-economic variables which were generated from the questionnaires survey were entered into PCA. The rational for this was to allow a reduction of these 37 variables to a few relevant variables which can be used to explain the socio-economic impact of the HPG in the study area. At the end of these exercise eight orthogonal components emerged. These components have various loadings. The pattern of loading significant varied from one

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component to the other. For the purpose of the study all loadings above 0.70 were selected for explanation. Altogether, 24 variables were found to be strongly loaded throughout the 8 components. The breakdown of which were 8variables on component 1, 4 variables on component 2, 4 variables on component 3, 4 variables on component 4, 2 variables on component 5, 1 variable each on components 6, 7 and 8.
A list of these variables is presented in Table 1 below.

a. Primary Characteristics of Respondents

The results of the questionnaire showed that 50% of the respondents are between the ages of 25 to 35 years. However, all the respondents are generally older than 25 years. In terms of nature of occupation, 60% of the respondents are farmers and 40% are fishermen, while 30% each are business men and civil servants. This pattern of distribution showed some levels of overlaps as many people double as fishermen and farmers. Also, some civil servants engage in some other occupation types. In addition, people of various extractions live and doing business around Shiroro. As showed Table 1, inhabitants do combine as much as 3 occupation types in some instances. For example, teaching, farming, trading or fishing. All the respondents are Muslims.

In terms of the level of education most of the respondents are relatively educated. For example, 30% each have primary school education. 10% each have tertiary and secondary school education, while 20% have no form of education. On the level of income, some of the respondents did not declare their income, possibly of the danger of taxation. However the report shows that the income of these respondents is relatively low, with about 10% of the respondents earning less than the national minimum wage of 7,500. In most households (40%) family sizes are greater than 15 people. However, in 10%of the household, family size are less than 5 people.

Table 1: Primary Characteristics of Respondents

S/N	Variable	Option	%
1	Age	Less Than 15 Years	
2		25-35 Years	20
3		36-45years	50
4		Greater Than 45years	20
5	Occupation	Farming	60
6		Fishing	40
7		Business/ Trading	30
8		Civil Servant	30
9	Religion	Islam	100
10		Christianity	0
11		Others	0
12	Education	Primary	30
13		Secondary	10
14		Tertiary	10
15		Arabic	30

16	Income	Less Than 7,500	10
17		7,500-15,000	20
18		C.16,000-20,000	0
19		Greater Than 20,000	20
20	Family Size	Less Than 5 People	10
21		4-10 People	10
22		11-15 People	20
23		Greater Than 15 People	40
24	Effects Of Dam On Fishing	Improved Fishing	30
25		Reduced Fishing	60
26		Cannot Say	0
27	Benefits Of Dam To Community	Dam Has Generated Employment	20
28		Dam Has Attracted Social Infrastructures	20
29		Dam Has Improved Security	10
30		Dam Has Improved Transportation	60

Source: Authors Field Survey 2010

On the effects of dam on the people, 60% of the respondents could not see any positive contribution the project has made on their livelihoods. This suggests that this dam must have contributed a little to their livelihood pattern. In the same vein, 60% are of the view that the greatest contribution of this dam is that it improved road network. For example, the new Shiroro after dam is now with tarred road and many feeder access roads with some other construction.

b. Components of the environment in Shiroro

The result of the principal components analysis used in rewriting the 40 socio economic variable is presented in Table 2. This shows that 11 components explained the variance in the equation. These components are presented below.

i. Component I: It has the highest contribution to the explanation with a contribution of 22.4%. It also has the highest number of variables loaded on it (9 variables), namely: residential status of inhabitants, effects of resettlement, land ownership, preference of residents and seasonality of job. Others are: impact of dam on job security, impact of dam on job seasonality, permanency of the impacts of resettlement and encroachment on artifacts sites. The component defining variable is religion of respondents.

ii. Component II has two significantly loaded variables. These are impact of dam on road network and impact of dam on developmental projects. This component is tagged rural development index. It has a contribution of 7.86% to the variance.

iii. Component III: This component has a contribution of 7.83% to the variance. It is significantly loaded on period of job engagement, benefit of dam to the community and

impact of dam on electricity. Period of job engagement is the component defining variable.

iv. Component IV: This component has a contribution 7.41% to the variance in the explanation. This component has high loading on benefits from available infrastructures and landownership. The component defining variable is landownership.

v. Component V: This component is strongly loaded on impact of project on women empowerment and access to land and water. This component has a contribution of 6.16%.

vi. Component VI: It has a contribution of 6.08% to the total explanation. It has 2 significantly loaded variables on income and family size. The factor defining component is family size.

vii. Component VII: This component has a significant loading on only one variable. This variable is tagged impact of project on culture. It has a contribution of 5.75%.

viii. Component VII: It has also significant loading on trade benefit of the dam. It has a contribution of 5.52%

ix. Component IX: this component has a significant loading 2 components which are: numbers of industry attracted and duration of residence. It has a contribution of 5.01%.

x. Component X: This component has significant loadings in extent of access to land and water resources. Ti has a contribution of 4.21%.

xi. Component XI: Employment benefit remains the only significant loaded variable on this component. It has the least contribution of 3.90%

Table 2: Environmental Impacts Assessment Components of Shiroro Dam

Rotated Component Matrix											
		Component									
		1	2	3	4	5	6	7	8	9	10	11
1	Age	-.245	-.054	.008	.050	.272	.134	-.101	.185	-.051	.594	-.133
2	Occupation	.529	.091	.121	.243	-.017	-.074	-.068	-.219	.098	.109	.596
3	Income	.242	-.137	-.126	.036	.046	.790	.271	-.044	-.033	.071	.175
4	Religion	.924	.156	.168	-.134	.026	-.023	-.018	.040	.108	-.087	.029
5	Residential Status	.897	-.082	.217	-.066	.215	.106	.067	-.046	.044	-.151	.079
6	Tribe	.592	.397	-.130	-.297	.344	-.165	.090	.253	.080	-.145	.048
7	Marital Status	.012	.007	.515	.387	.293	-.103	.505	-.045	.216	-.030	.144
8	Family Size	.071	-.096	.068	.033	.142	.856	-.152	.039	.041	.141	.039
9	Highest Education Level	.502	-.232	-.115	.059	.015	.220	-.417	-.073	.253	.371	.044
10	Duration Of Residence	-.124	-.018	-.056	.081	-.030	-.099	-.152	-.070	-.827	-.007	-.074
11	Effects Of Movement	.708	.316	-.201	.251	.064	.103	.176	.173	-.010	-.182	-.088
12	Effect Of Resettlement On Landownership	.925	.156	.168	-.134	.026	-.023	-.018	.040	.108	-.087	.029
13	Preference Of New Residence	.897	-.082	.217	-.066	.215	.106	.067	-.046	.044	-.151	.079

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14	Effects Of Resettlements	.520	-.122	.206	-.155	.026	-.266	.419	.228	.045	-.061	.250
15	Safety Of New Residence	-.110	.022	.046	.574	.143	-.172	.183	.085	.294	.558	.066
16	Specific Security Problem	.268	-.181	.054	.336	.126	.005	-.099	.604	.282	-.059	.372
17	Access To Land And Water	.332	.016	.093	.217	.798	.179	.018	.116	.182	.057	.062
18	Degree Of Access To Resources.	-.125	-.005	-.069	-.263	-.050	.359	.130	.084	-.368	.637	.086
19	Seasonality Of Job	.713	.147	-.159	-.028	-.140	-.336	.294	.075	.213	.151	.000
20	Period Of Engagement	.352	.038	.724	.183	-.051	.169	.029	.078	.061	-.089	.234
21	Impact Of Dam On Job Seasonality	.846	-.059	-.096	-.068	.309	.282	.087	.011	.086	.076	-.008
22	Effects Of Dam On Fish Catch	.180	.313	.235	.345	-.460	-.124	.482	.089	.216	-.011	-.006
23	Permanency Of Impacts	.708	.257	.364	.021	-.148	.111	.002	.034	.110	-.127	-.107
24	Benefit Of Dam To Community	.025	-.164	.669	-.403	.050	.020	.143	.127	.170	.159	-.185
25	Employment Benefits	.109	-.084	.109	.158	.125	-.336	-.076	-.056	.173	.087	-.666
26	No Of People Employed In The Dam	.400	.153	-.249	-.137	-.155	-.225	-.382	.015	.338	.128	-.239
27	Benefits From Available Infrastructures	-.139	.121	-.027	.703	-.222	-.049	.281	.165	-.131	-.052	-.148
28	Trade Benefits From The Dam	-.053	-.064	.231	-.073	.104	.120	.029	.834	-.066	.237	-.159
29	No Of Industries Attracted By Dam	-.210	-.063	-.086	-.296	-.147	.135	-.014	.011	-.657	.148	.225
30	Who Owns Land	-.081	-.031	.065	.808	.300	.169	-.008	.001	.116	-.009	.040
31	Encroachment Of Dam On Artifacts.	.687	.256	.103	.311	.212	.129	.158	.199	-.021	.034	-.015
32	Impact Of Project On Culture	.298	-.024	.028	.143	.100	.162	.842	.069	.144	.074	-.056
33	Impact Of Project On Women Empowerment	.255	.125	.066	.043	.837	.026	.144	.098	.025	.175	-.179
34	Specific Contribution On Empowerment	.285	-.093	-.086	.306	.067	-.157	.333	.590	.092	.121	.087
35	Impact Of Dam On Electricity	.154	-.049	.712	-.011	-.021	-.098	.028	.565	.014	-.128	-.046
36	Impact Of Dam On Water	.374	.343	.612	.142	.175	-.253	-.001	-.069	-.125	.084	-.143

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37	Impact Of Dam On Schools	.644	.324	.316	.292	-.025	-.082	-.037	.181	.078	.226	-.113
38	Impact Of Dam On Hospitals	.426	.516	.456	.191	.179	-.147	.083	-.169	-.124	-.038	-.320
39	Impact Of Dam Road Network	.157	.956	-.002	.021	.015	-.080	-.011	-.085	.040	-.020	.056
40	Impact Of Dam On Development Projects	.157	.956	-.002	.021	.015	-.080	-.011	-.085	.040	-.020	.056
Eigen value		**8.97**	**3.14**	**3.13**	**2.96**	**2.46**	**2.43**	**2.30**	**2.21**	**2.05**	**1.68**	**1.56**
Percentage variance (%)		**22.4**	**7.86**	**7.83**	**7.41**	**6.16**	**6.08**	**5.75**	**5.52**	**5.01**	**4.21**	**3.90**
Cumulative percentage (%)		**22.4**	**30.3**	**38.1**	**45.3**	**51.7**	**57.8**	**63.5**	**69.0**	**74.0**	**78.2**	**82.1**

Source: - Authors Estimation

The above showed that there are 11underlying components of environmental impacts around the Shiroro projects. These are: religion, component of development, period of job engagement, land ownership, women employment, family size and culture. Others are: direct of benefits, duration of residence, degree of access to resources and employment benefit. All these components offered 82.1% explanation to the variance in the explanation.

All the respondents in Shiroro are all Muslims. This executed in the study as Islam is a popular religion among the Gbagis of Niger sate. Also in the Shiroro project, the issue of resettlement is an important issue as government resettlement efforts was directed at financial compensation alone and not housing project as the usual case in the Jebba and Kainji dam. More importantly, the issue of resettlement was abused to the extent that many of the victims were given bags of fertilizers alone. In some instances developmental projects such as water schemes were manipulated. In many localities the people were left in the endemic flood plain and many died eventually. The project has also impacted positively on road development, particularly road network as many communities that were hitherto not accessible previously are not accessible by road. Shiroro now has a tarred road and this has facilitated some movement in the region. In the same vein, it has also imparted positive on some development projects. The dam project has also made employment seasonal as during the flood season, the people are now idle as it becomes difficult to do some farming while fishing becomes rather difficult in view of the velocity of flow along the channel. The dam project has also affected land ownership. Prior to the dam, land belong to the King, but with the project land is now been sold as land becomes scarce, the resettled individual now has to lease land. This has led to communal clashes that have claimed lives. Furthermore, the Gbagi women of Shiroro that were previously known for their seclusion are been forced to come out of their position to now seek for paid employment as they now have to support the family this is the case in Shiroro and its immediate neighborhood. The size of the family is also been affected by the project. The size of the family is has been reducing as modernization and poverty has led to the emergence of smaller family sizes

The culture of the people is also affected by the dam, as many of the masquerades and cultural fairs are no more existence, many festivals has been cancelled, many of the

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shrines have now been permanently impounded. Also, several artifacts and burial ground are now permanently covered with water. A case in point is Galadima Kogo where as much as 15 traditional festivals have been cancelled. Little form of trading impact has been observed. According to respondents some of their markets are now expanded, and destination of traders are now widened as many traders now come from different parts of the country to trade in Shiroro market. Also, the scope and variety of goods they got also differs. The expanded trade has allowed them to have access to goods from every part of Nigeria as traders from different areas now besiege Shiroro markets particularly on market days. Further, no specific industries have been attracted to the area. The reason for this may not be unconnected to the fact that Shiroro has no infrastructural facilities. For example, up to the time of the field work for this project there was no presence of a single bank in Shiroro. The project has also provided assess to fishing water as the poundage has made more water available for fishing. This impact is more felt in Shiroro area in view of the nature of ruggedness in the dry season. The surface area of the dam is now wider and has made fishing worthwhile although, fishermen are prohibited from fishing inside the bay of the reservoir for safety reasons. However water is now abundant in the dry season. In the same vein, land has not been a big issue apart from Shiroro Township where some cases of land dispute has been cited. Indeed, in other areas people have a traditional understanding about land. This arrangement is normally arranged by the traditional ruler of Shiroro and supervised by the Emir of Mina. The respondents are of the opinion that they have very fair access to these resources. Finally, some trickles of employment were also made by PHCN, although employment opportunities are made at the lowest level, as some of the indigenes are now cleaners and guards in the project. The issue of employment has constantly generated a lot of problems between the indigenes, it has led to protests. The PHCN authorities has always explained this in terms the lack of professionals amongst them as many of the indigenes are not employable in view of the high illiteracy rates in Shiroro and judging from the backdrop that PHCN is highly technical and professional organization..

V. Analysis and Predicting the Impact of Dam Project on the Socio Economic Environment in Shiroro

The result of the factor analyses was later used as input into a multiple regression model. The result of the multiple regression analysis showing relationships between social economic environmental impact assessment components and the hydropower projects in Shiroro. This is presented in Table 2. This clearly shows that all the rotated components scores together make a contribution of 81.2% to the variance in the explanation.

Table 3: Multiple Regressions Predicting the Impact of Dam Projects

Coefficients							% Variance Explained
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	
		B	Std. Error	Beta			
	(Constant)	.977	.092		10.63	.000	

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	1. Effect Of Resettlement On Landownership (RESE)	1.635	.093	.846	17.60	.000	92.8
	2. Economic Infrastructure (ECIF)	-.114	.093	-.059	-1.231	.228	
	3. Job Seasonality Due To Dam (JOBS)	-.186	.093	-.096	-1.997	.055	
	4. Specific Benefits Of Dam (BENE)	-.131	.093	-.068	-1.412	.168	
	5. Access To Land And Water (RESO)	.597	.093	.309	6.425	.000	
	6. Family Size (FAMI)	.544	.093	.282	5.858	.000	
	7. Impact On Culture (CULT)	.168	.093	.087	1.806	.081	
	8. Trade Benefits Of Dam (TRAD)	.022	.093	.011	.232	.818	
	9. Industries Attracted Due To The Project (INDU))	.166	.093	.086	1.789	.083	
	10.Access To Resources (RESO)	.147	.093	.076	1.581	.124	
	11. Employment Benefits (EMPL)	-.016	.093	-.008	-.174	.863	

Source Authors Estimation 2011

Equation 1

Y= 0.977+ 1.635RESE- 0.114ECIF- 0.186JOBS+ 0.131BENE+0.597RESO+ 0.544FAMI+0.168CULT+0.022TRAD+0.166INDU+0.147RESO- 0.16EMPL……eq 1

(R^2=92.8%; SE=0.093)

The stepwise regression analysis showed that the socio-economic impact of the Shiroro dam project on the immediate community can be in respect of only 3 components. These components are: economic infrastructure, family size and impact on culture; they jointly contributed 89.0% (Table 4 and equation 2). The importance of these components cannot be over flogged. For example, the improvement in road network appeared to be the only positive impact of the project. Despite this, it has as much as 71.6% on explanation on the variance. The impact of road on social economic lives has multiple effects on the people. It has improved diffusion of innovation; it has affected trade, social interaction and so on. There is a changing family size among the people as smaller family sizes are now noticed. This offered about 9.5% explanation. Reasons for this are increasing poverty, changing culture, influence of western civilization, etc, attributed to the coming of the project. The impact of the dam on culture is also an issue, cultural festivals have been stopped. For example in Zumba Muwo and Abwagyi festivals have been stopped. In Shiroro town Abwagyi dance festival has been stopped, in Galadima Kogo fishing regatta has been stopped. In Guni about 20 traditional festivals were stopped, prominent among them are: Zakwolotu, Abwagyi, Amumu, etc have all stopped. Part of the reasons is that the herbs and the costumes and some rituals meant for the festivals are no more available. The sites are completely impounded with water. Artifacts have been lost and some forms of traditional religions could not be practiced. This would have affected the

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social lives of the Gbagis as many young children particularly those born after the projects would have little or no idea about the holistic culture of their people. This component offers as much as 8% explanation. The pattern of association can be explained by equation 2 and table 4 below.

Y=0.977+1.635ROAD+0.597FAMZ+0.544CULT……eq 2
R2=89; SE=0.103

Table 4: Stepwise Multiple Regression Predicting the Impact of Dam Projects

Coefficients								**% Cumulative Variance Explained**
		Un-standardized Coefficients	Standardized Coefficients	T	Sig.		% Variance Explained	
Model		B	Std. Error	Beta				
	(Constant)	.977	.101		9.63	.000		
	1. Economic Infrastructure (ECIF)	1.635	.103	.846	15.94	.000	71.6	89.0
	2. Family Size (FAMZ)	.597	.103	.309	5.82	.000	9.5	
	3. Impact On Culture (CULT)	.544	.103	.282	5.31	.000	8.0	

Source: Authors Estimation.

One can therefore conclude that though the Shiroro dam project has little or no positive impact on the socioeconomic life of the riparian community. One would have expected that the dam would impact positively on the socio-economic life of the people around it but rather little influence of the dam can be felt. It has no effect on electricity and other infrastructure. This suggests that government need to assist these communities.

Conclusions and Recommendations

1. The operations of Shiroro dam have both negative and positive effect on communities around the dams, especially those that are about 1,500 meters away from the river bank on regular time interval of four years when the rivers overflow its bank or irregularly when the PHCN open the spillway.

2. The effects are mostly felt in the area of income generating activities (Farmland and Crop destruction, Fishing Pounds) property ownership (destruction of houses and loss of Ancestral land and Artifacts)

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3. The Communities mostly affected are those downstream of the confluence of Rivers Niger and Kaduna Patigi, Esungi, kpataparadogi, Egwamama Edochi and Ellah in Patigi LGA, Lipata, Lafiaji, Chewuru, and Tada in Edu LGA of Kwara state. Other locations affected are Kuta, Shiroro, Galadima Kogo, Zumba, and Guni, all in Shiroro LGA of Niger state.

4. The adjourning flat land (about 46 sq km) stretching from old Muregi at the bank of the confluence to New Muregi has remained uncultivable for a very long time. The Agricultural and hydrology experts are of the opinion that with adequate irrigation facility, the plain can supply the region with enough rice provided that the river is prevented from over flow its bank. The soil test conducted affirmed the opinion of the Agricultural expert.

5. There is inadequate organized safety net (compensation) for the dam affected communities visited, most of who lack basic strategic social and production infrastructure including electricity (e. g Shiroro Village). The dams have not created employment opportunity for the people in the host communities, a situation that is almost and always inducing local protest.

6. The potential benefits of the rivers have not been adequately tapped by the riverine communities as a result of absence of the necessary strategic social and economic infrastructure. (Inland Water Way, Boat Making and Sandy Sunny Beach at Muwo as Tourist Haven and commercial fishing)

In view of the above conclusions, the following recommendations were proposed.

Enactment of Local Content Law for Hydropower Producing Areas;
Local content in any organization and in the case of the hydropower dams refers to the recognition, initiation and operationalization of the participation in all forms of activities leading to the production, transmitting and distribution of the products of the operations of hydroelectricity dam by the host community to the dams. As it is obvious from the outcomes of the studies, this does not exist in any of the three dams. It is important that this be incorporated into the laws of Nigeria. The rational for this is that with the participation of the indigenes in all operation of the hydro dams, the losses occasioned by the operation of the dam would have been mitigated by the flow of income from the local content. By operation we refer to all regulatory authorities, contractors, operators, sub- contractors, alliance partners and any other forms of activities that may be connected to the operation of the dams. Apart from the employment effects of the local content principle, it has the tendency to instill the spirit of nationalism and sense of belonging to the host communities. It is imperative therefore that the law on local content for all hydropower dams must be enacted, and enforced. In this respect the study is suggesting a thirty percent (30%) local content to be provided by the host communities. (The proposed Local Content Bill has been prepared as appendix to this report).

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Audit of Strategic Social and Economic Infrastructure;

The general decay and complete absence of Strategic Social and Economic Infrastructure reflects the failure of government at all levels in the dam affected areas. The dam authorities also have not gone to any appreciable level to ameliorate the conditions of the host communities, simply because it they presume that is outside their mandate. However social responsibility confers on the authority an added duty to mitigate the adverse effect of the operations of the dam in the host communities. This has engendered visible social tension replica of what obtains in the Niger Delta occasioned by pockets of agitation by Youth Organizations in the affected communities. It should therefore be a thing of interest to solve the problem of decaying and complete absence of social and production infrastructure. This can be done first by conducting audit of the available Strategic Social and Economic Infrastructure to establish the type, number, state, quality and desired level of investment.

Checkmating the Perennial Flooding through building of Dykes, embankment, and dredging;

It is inherently clear that the perennial flooding had caused colossal damages to the lives and property of the host communities, including the destruction of aquatic life, fauna and flora. In particular the distortion caused to ecological landscape, farmlands and fishing ponds cannot be estimated by mere hearsay, guesses or imputation. The regime of compensation did not also erase the memory of the effects. This is particularly so with the degree of unanimity in the response to the survey instrument by the entire affected communities. To arrest the situation it is important to find a lasting solution to the flooding problem. The use of structural and non-structural methods to solve the problem is hereby advocated. The erection of Dyke along the human inhabited bank of the river will provide protection to the communities, while flood warning signals should be made several days before the release of water. This is particularly necessary in locations like Garafini, Old Muregi, and Gbajibo in Niger State and Esungi, kpataparadogi, Egwamama Edochi and Ellah in Patigi LGA, Lipata, Chewuru, and Tada in Kwara state. No doubt this will require some engineering details, which is beyond the scope of this survey. The Engineering design of the dyke should be initiated immediately by involving the appropriate River Basin Development Authority, Federal Ministry of Environment, The Ecological Fund, and the Nigerian Emergency Management Authority.

Revisiting the Resettlement Scheme;

The trauma occasioned by the displacement from Ancestral land is not always viewed anywhere in the world with levity. This is why a scheme of resettlement is made a replication of what obtains in the area, reflecting socio-cultural affiliations, religious practices and socio-norms and traditional architecture. Apart from the resettlement schemes of Kainji, Shagunu and Gbajibo (which does not even reflect some of the attributes mentioned above) no organized resettlement scheme is put in place for the affected communities along River Kaduna. Places like Shiroro and Lavun Local Government Areas are typical examples. The existing resettlement areas need to be upgraded as most of the facilities put in place are no longer functioning efficiently. New and improved schemes are needed in other communities to relocate the villages prone to flooding.

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Creating a Conducive Environment for Constructive Engagement;

The operational activities at the dams, have led to lose of their traditional craft and cottage industries. These are environmental problems occasioned by perennial flood, leading loss of soil nutrients and by extension soil fertility, pollution of fishing ponds causing low fish catch, and displacement from ancestral farmland causing poor harvest. This has left many people in the affected communities unemployed or underemployed. This therefore calls for empowerment of people – particularly women and youth. In this connection all the three tiers of government should collaborate to initiate and cause to establish micro and small scale enterprises that have bearing to local craft and cottage industry. Such could include Fish Smoking, Boat Building, Fishing Net Making, Agro food processing, etc.

Responsiveness of the States and Local Governments

There is incontrovertible evidence that the presence of Sates and Local governments in the affected communities is not felt or non-existence. Basic amenities which are exclusive preserve of the states and local government are either not available or non-existing and where available, not accessible. Township and village roads, market squares, clinic and maternity centers, schools and other social amenities, particularly in the area are either not available and where available not accessible and where accessible not functional because they are either poorly equipped and badly maintained. The people in the communities are living in difficult and hash conditions thus creating pockets of agitation while blaming it all on the Dam Authority. As a starting point, a scheme of joint financing for infrastructure rebirth for affected Communities could be instituted. The scheme could be designed to involve federal state, local and dam Authority to be supervised by the newly created Hydropower Area Development Commission (HYPADEC). This will create a platform for the take-off HYPADEC.

Evolution of an appropriate regime of Compensation for the Dam Affected Communities

The communities have been hosting the hydroelectric power stations and coping with it associated vagaries of pains and losses. For hosting the hydropower stations between 20 to 40 years communities should be granted a regime of compensation that will help to mitigate the adverse effects of dam operations. Virtually all the communities where a scheme of compensation was put in place as the time of water impoundment are now crying foul of the exercise. The youth and the elderly who are living witness complaint of exploitation of their forefathers. In other to redeem those losses that were caused by the exploitation of their illiterate forefathers, it is imperative that the regime of compensation must be revisited. This could be executed through a joint funding arrangement between the different Dam Authorities, the federal, the state and the local government. It is here suggested that the fund contribution can take the form 20%, 30%, 30%, and 20% respectively.

Bibliography

Baskaya, S; Baskaya, E; And Sari, A. (2011), The Principal Negative Environmental Impacts Of Small Hydropower Plants In Turkey. *African Journal of Agricultural Research* 6(14):3384-3290.
Berkermman, M. (1995), How Would You Like Your Sustainability Sir? Weak or Strong? A Reply to My Critics; *Environmental Values.* 4(2): 167-179.

Bhandari, B., (1992) "The current status of wetlands in Nepal, country report presented at the Asian Wetland Symposium (14-20 October 1990, organized by Ramsar Center, Japan), Otsu/Kushiro, and Japan: Ramsar
Brabdt, S.A. (2000), A Tale of Two World Bank Financed Dam Projects In The Horn Of Africa. *World Commission on Dams: Dams and Cultural Heritage Management. Final Report*, August 2000. Working Paper Submitted To WCD By Steven, A. Brandt And Fekri Hassan. World Commission on Dams Secretariat P.O. Box 16002 Vlaeberg, Cape Town 8018, South Africa, *http//www.Dams.Org*.

Daily Times Nigeria (2011) Shiroro Community Appeals for Improved Living Standards. *Daily Times of Nigeria* 23rd August, 2011.

EIA (Kaligandaki 'A' Associates), (1996), Kali Gandaki 'A' Hydroelectric Project Detailed Design, Environment Impact Assessment, Kathmandu: KGA—Morrison Knudsen Corporation (USA), Norconsult International (Norway) and IVO International (Finland).

Graf, W.L. (1999) Dam nations: a geographic census of American dams and their large scale hydroelectric impacts, university of South Carolina scholar commons. *Water Resources Research* 35 (40 1305-1311.

Hassan, F.A. (2000), The Aswan High Dam And the International Rescue Campaign. *World Commission on Dams: Dams and Cultural Heritage Management. Final Report*, August 2000. Working Paper Submitted To WCD By Steven, A. Brandt And Fekri Hassan. World Commission On Dams Secretariat P.O. Box 16002 Vlaeberg, Cape Town 8018, South Africa, *Http//Www.Dams.Org*.

Inskeep, R. (2000), Pikirayi Hydroelectric Dams: The Impacts of the Construction on Local Communities and Implications for Cultural Heritage. *World Commission on Dams: Dams and Cultural Heritage Management. Final Report*, August 2000. Working Paper Submitted To WCD By Steven, A. Brandt And Fekri Hassan. World Commission on Dams Secretariat P.O. Box 16002 Vlaeberg, Cape Town 8018, South Africa, *http//www.Dams.Org*.

International Hydropower Association (IHA) (2003), the Role of Sustainable Hydropower. IHA. White Paper. London. Available at: www.hydropower.org/downloads/roleofhydropowerinsustdevIHA%20white.pdf

Jha, J. & Chaudhary, R., (2003), Hydropower development and fish diversity, a paper presented at the Workshop on Hydropower Dams: Impact on Fish Biodiversity and Mitigation Approaches, Kathmandu.
Karki, S., (2000), Dams and Development: Translating Global Recommendations to National Agenda and Action in Nepal Water, Wetlands and High Mountains, Kathmandu, International Union for Conservation of Nature.
Kinahan, J. (2000), Lessons from Angolan-Namibian lower Cunene hydropower scheme. *World Commission on Dams: Dams and Cultural Heritage Management. Final Report*, August 2000. Working Paper Submitted To World Commission on Dams Secretariat Cape Town South Africa, *http//www.Dams.Org*.

Kovalevsky (JR), W. P. (2007), Wind energy development and wildlife conservation challenges and opportunities. *Journal of Wildlife Management*. 71 (8) 2487-2498).

Louis, V. L; Kelly, C. A; Duchemin, E; Rudd, J. M. and Roseberg, D. M. (2000), Reservoir surfaces as sources of green house gases to the atmosphere, a global estimation. *Biosciences* 50 (9): 766-775.
Makinen, K. and Khan, S. (2010), Policy consideration for greenhouse gas emission from freshwater reservoirs, *Water Alternatives* 3(2): 91-105

Niemeyer, E. (2003), *Weak versus Strong Reliability: Exploring the Limits Two Opposing Paradigms,* 2nd ed. Cheltenham and Northampton. Edward Elgar Publishing.

Pradhan, B.R., 1987, Potential of reservoir fisheries development in Nepal, a paper prepared for the Workshop on Reservoir Fishery Management and Development in Asia (23–28th November), Kathmandu.
Rai, A.K., 1989, Final Progress Report (16 July 1984–31 December 1989), Inland Fisheries Project, Kathmandu: Fisheries Development Division, National Agricultural Research and Service Centre, Ministry of Agriculture, Government of Nepal.
Schumann, K, Saili, L; Taylor, R; Abdel-Malek, R. (2010), Hydropower and Sustainable Development: A Journey. An Article Submitted to Energy Congress 2010. International Hydropower Association.

Shrestha, J. & Chaudhary, R., 2003, Fish biodiversity in Kali Gandaki River: Before and after the dam construction, in Proceedings on Hydropower Dams: Impact on Fish Biodiversity and Mitigation Approaches, Kathmandu: Nepal Agricultural Research Council (NARC) and Nepal Electricity Authority (NEA).
SMEC (Snowy Mountain Engineering Company), 2000, West Seti Hydroelectric Project: Environmental Impact Assessment, vol. 1, Cooma, NWA, Australia: SMEC.
THE NATIONS (2009) Shiroro gives light to Nigeria, remains in darkness *THE NATIONS* 12th June, 2009
THE PUNCH (2009), Protesting youth disrupt operations in Shiroro dam. *PUNCH*, 6th May, 2009

International Journal of Academic Research in Business and Social Sciences
April 2012, Vol. 2, No. 4
ISSN: 2222-6990

World Commission on Environment and Development (WCED) (1987), *Our Common Future*. Chapter 2: Towards sustainable development. Geneva, available at: http:llwww.undocuments.net/oct-o2htm.